ANL-6432

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Argonne National Laboratory

PHYSICS DIVISION

SUMMARY REPORT

September-October 1961

ANL-6432
Physics
AEC Research and
Development Report

ARGONNE NATIONAL LABORATORY
9700 South Cass Avenue
Argonne, Illinois

PHYSICS DIVISION SUMMARY REPORT

September-October 1961

Morton Hamermesh, Division Director

Preceding Summary Reports:

ANL-6358, April, May 1961
ANL-6376, June 1961
ANL-6391, July, August 1961

Operated by The University of Chicago

under

Contract W-31-109-eng-38

FOREWORD

The *Summary Report of the Physics Division of the Argonne National Laboratory* is issued monthly for the information of the members of the Division and a limited number of other persons interested in the progress of the work. Each active project reports about once in 3 months, on the average. Those not reported in a particular issue are listed separately in the Table of Contents with a reference to the last issue in which each appeared.

This is merely an informal progress report. The results and data therefore must be understood to be preliminary and tentative.

The issuance of these reports is not intended to constitute publication in any sense of the word. Final results either will be submitted for publication in regular professional journals or, in special cases, will be presented in ANL Topical Reports.

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I-60- 7.7-Meter Bent-Crystal Spectrometer (ANL-6235, November 1960), Robert Smither.

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V-14- Properties of Nuclei with Neutrons and Protons in the $1f_{7/2}$ Shell (ANL-6391, July-August 1961), R. D. Lawson.

V-15- Statisical Properties of Nuclear Energy States (ANL-6288, January-February 1961), Norbert Rosenzweig.

V-33- The Aharonov-Bohm Effect (ANL-6358, April-May 1961), L. J. Tassie and Murray Peshkin.

I. EXPERIMENTAL NUCLEAR PHYSICS

I-11-29 Installation and Operation of the Van de Graaff Generator (51210-01)

Jack R. Wallace

This report covers the operation of the 4.5-Mev Van de Graaff generator in the Physics Division for the period from April 1 to September 30, 1961, inclusive.

Protons, deuterons, and alphas were accelerated by the generator. The accelerating potential of the generator varied from 0.8 Mv. to 4.2 Mv. The resolved beam currents measured at the target varied from 0.2 to 30.0 μa.

The types of experiments, the experimenters and the operating time of the generator for the various experiments are shown below.

1. Fission cross section	Stupegia	208.5 hr
2. Total cross section and capture cross section of boron	Huddleston, Mooring	184.1
3. Total neutron cross sections in the kev region	Hibdon	412.0
4. Polarized protons from Ti^{48} (d, p)	Smither, Weinman	102.2
5. Alpha-gamma reactions	Lee, Meyer-Schutzmesiter, Malik, Weinman	196.4
6. Neutron polarization	Elwyn, Lane, Langsdorf	190.5
7. Characteristics of scintillation detectors	Yook	63.0
8. Radiation damage studies on silicon	Dayal	53.6
	Total	1410.3
Start-up and daily maintenance		86.5
Generator repairs and experimental setups		705.2
Generator remodeling - Langsdorf		190.0
Total time available (126 days × 16 hr/day + 47 days × 8 hr/day)		2392.0 hr

Many changes were made in the generator and its associated control circuits in an effort to further improve its performance. The experimental schedule with the machine was light, so that time was allowed for changes which will be outlined below.

Van de Graaff generators with more than one voltage-dividing electrode have regulated their voltage by a control circuit acting through a set of corona needles extending through the pressure vessel to the outermost electrode. This has been a part of the method of keeping the generator at a selected voltage. This system has its drawbacks because it does not directly control the highest voltage electrode. At several laboratories where there were such generators, it was believed that more stable operation and faster voltage correction could be obtained if the electric field of the corona needles used in the control could reach the highest voltage electrode. Since the generator design made it impossible to eliminate these additional electrodes, holes were cut through these electrodes so the electric field of the control needles could "see" the high-voltage electrode. It was discovered that proper sized holes with smooth rounded edges gave the desired results without affecting the other function of the intermediate electrodes. Under the direction of Dr. A. Langsdorf, our large outer electrode and the intermediate electrode have had holes cut in them.

A new voltage control tube (6BK4) has now replaced the 4E27 previously used. The control circuit has been modified to accomodate this change. The tube characteristics of the 6BK4 are better suited to this purpose.

Corona gap needles have been replaced to improve the uniformity of the voltage gradient down the accelerating tube. This becomes necessary from time to time since the needles become blunt and the spacing increases with use. Both changes affect the voltage gradient.

In a further effort to improve belt life and machine performance, a new low-starting-torque $7\frac{1}{2}$ - hp belt-drive motor has been installed with a new type of flexible coupling to transmit its power to the belt-drive pulley.

An electromagnet and remotely operated oscillator grid condenser have been added to the ion source of the generator. It is hoped that these will improve the maximum current obtainable from the ion source.

The use of an alternating-gradient magnetic-lens system on the ion beam going to the 90° spherical-plate electrostatic analyzer has increased the amount of beam reaching the target. No effect in resolution of the analyzer has been noticed when all components are carefully aligned.

I-33-2 Decay of Tm^{172} (51210-01)

S. B. Burson and R. G. Helmer

This project has been completed and the results have been published in a report entitled "Decay of Tm^{172}," R. G. Helmer and S. B. Burson, Phys. Rev. 123, 978-991 (August 1, 1961).

I-34-2 Decay of ${}_{68}Er^{172}$ (51210-01)

S. B. Burson and R. G. Helmer

This project has been completed and the results have been published in a report entitled "Energy Levels in ${}_{69}Tm^{172}$ from the Decay of ${}_{68}Er^{172}$," R. G. Helmer and S. B. Burson, Phys. Rev. 123, 992-996 (August 1, 1961).

I-98-28 Unbound Nuclear Energy Levels in the Kev Region

(formerly "Neutron Total Cross Sections in the Kev Region")

(51210-01)

Carl T. Hibdon and J. E. Monahan

FLUORINE

1. Measurements

The study of the nuclear energy levels of F^{20} by the $F^{19}(n,n)$ process up to about 150 kev was reported previously[1] and the analysis of the levels given. The general features of the resonances up to 150 kev are shown in Fig. 24 of reference 1. These measurements have now been extended up to about 390 kev and a sizable number of resonances were observed. Some analyses have been attempted up to about 280 kev but are not in final form and hence are reserved for a later report. These analyses are complicated by the presence of inelastic neutron scattering in this region. Above 300 kev the data are not yet processed.

2. The 27-kev Resonance

The peak height and hence the spin of the level responsible for the 27-kev resonance have recently been studied further. Lane, Morehouse, and Phillips[2] employed a technique for the determination of the true resonance shape from a measured resonance shape when the instrumental resolution function is known, or, conversely, for the determination of the resolution function if the resonance shape is known. They used the 2.08-Mev resonance in C^{12} to find a neutron distribution. This method, with the resolution function they found, has been applied to the

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[1] C. T. Hibdon, Physics Division Summary Report ANL-6326 (March, 1961), p. 35.

[2] R. O. Lane, N. F. Morehouse, and D. L. Phillips, Nuclear Instr. and Methods 9, 87 (1960).

flat-detection data on the 27-kev resonance. The program was set up by Mary Welsh and N. F. Morehouse of the Applied Mathematics Division and the calculations were performed by Mary Welsh with the IBM-704 computer. The results are shown in Fig. 1. The neutron distribution used, normalized to a width of 400 ev at half its maximum height, is shown in the insert. The solid curve in Fig. 1 is the multiple-level plot obtained before. This theoretical curve was then combined with the neutron distribution shown in Fig. 1 in order to find the measured cross section to be expected for a neutron energy spread of 400 ev. The calculated points shown by crosses are to be compared with the flat-detection data shown by open circles. Points obtained by self-detection are shown by solid circles. One sees that, for an effective neutron energy spread of 400 ev, this method duplicates the flat-detection data except out in the wings of the resonance. A fit could not be expected in the wings because a single-level expression was used in the present method of analysis and it has been shown previously[1] that the shape of the wings of this resonance are modified by mutual interference with other resonances. This method of analysis then indicates that the spin for this level is J = 2 and that the neutron energy spread is close to 400 ev. It was shown previously[1] that

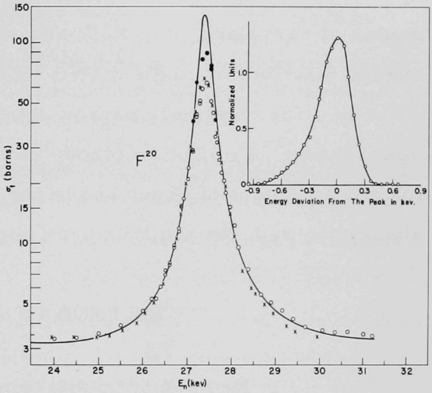

Fig. 1. Neutron cross section of fluorine in the region from 23 to 31 kev. Data obtained by flat detection are shown by open circles. Solid circles show the data obtained by self-detection. Points shown by crosses were obtained by the method of analysis given by Lane, Morehouse, and Phillips. They represent the flat-detection data to be expected with a neutron energy spread of 400 ev if the shape is as shown in the insert. The solid curve was obtained previously by multiple-level analysis.

the observed width of this level indicated a value of 400 ev for the over-all neutron energy spread. This method of Lane et al., however, provides no means by which the flat- and self-detection data can be used together and corrected for the neutron distribution in order to obtain the value of J.

Monahan and Hibdon have given quite serious thought to a means of correlating the flat- and self-detection data and the neutron energy distribution in an analytical method for determining the correct value of J for relatively narrow levels. This method will be outlined in the next section. For both methods of analysis, the best results are obtained for a peak height of about 124 barns. This value results because neutron absorption reduces the true peak height by the factor Γ_n/Γ.

METHOD OF ANALYSIS

Neutron transmission is frequently measured by a self-detection method in this laboratory. Essentially, the method involves the determination of the ratio of the number of neutrons scattered by a detector sample with and without a filtering of the incident beam by a transmission sample. Two cross sections are determined in this manner. One, called the "flat-detection" cross section σ_f, is measured by use of a detector sample whose scattering properties are insensitive to a change in the energy of the incident beam. The other, called the "self-detection" cross section σ_s, is measured with a detector sample made of the same material as the transmission sample.

The purpose in this note is to point out that given the measured values σ_f and σ_s: (i) it is possible to test for unresolved structure in the microscopic cross section of the transmission sample, (ii) in cases in which the measured cross section is only partially resolved, it is possible to obtain a better estimate of the true value of the cross section than either σ_f or σ_s separately, and (iii) in certain cases it is possible to obtain a meaningful upper bound for the associated absorption cross section.

An example of each of these assertions is provided by the analysis of scattering data in the neighborhood of the 27-kev resonance in F^{19}. The data are given in Table I in terms of the cross sections

TABLE I. The measured flat- and self-detection cross sections in the neighborhood of the 27-kev resonance in F^{19}. The first three columns list respectively the mean energy of the neutron beam, the measured flat-detection cross section, and the measured self-detection cross section. The fourth and fifth columns contain respectively the average cross section and its root-mean-square deviation.

E (kev)	$\sigma_f(E)$ (barns)	$\sigma_s(E)$ (barns)	$\sigma_a(E)$ (barns)	$\sqrt{\delta^2(E)}$ (barns)
27.10	28.6	40.6	34.5	20
27.20	43.7	63.2	56.7	44
27.30	59.0	83.0	75.3	49
27.40	52.3	75.5	73.9	62
27.50	50.1	77.1	67.7	53
27.60	34.1	41.9	37.0	20

$\sigma_f(E)$ and $\sigma_s(E)$ and in terms of $\sigma_a(E)$ and $\sqrt{\delta^2(E)}$ which can be obtained from σ_f and σ_s in a straightforward manner. These derived quantities are defined by the relations

$$\sigma_a(E) = \int \rho(\epsilon - E)\, \sigma(\epsilon)\, d\epsilon \tag{1a}$$

and

$$\delta^2(E) = \int \rho(\epsilon - E)\left[\sigma(\epsilon) - \sigma_a(E)\right]^2 d\epsilon \quad , \tag{1b}$$

where σ is the microscopic cross section of the transmission sample, ρ is the resolution function that describes the energy distribution of the incident neutron beam, and E is the mean energy of this beam. The large values of $\sqrt{\delta^2(E)}$, the root-mean-square value of δ, for values of E near the resonance energy indicate that the cross section has not been completely resolved for these energies. Further, since Eq. (1b) implies that for some energy $\bar{\epsilon}$ for which ρ is finite we have

$$\sigma(\bar{\epsilon}) \geq \sigma_a(E) + \sqrt{\delta^2(E)} ,$$

it is seen that the right-hand side of this inequality is a better estimate of $\sigma(E)$ than either $\sigma_f(E)$ or $\sigma_s(E)$. Finally, since the upper bound of the total cross section is set by the condition

$$\sigma(\epsilon) \leq 4\pi\lambda^2 g_J \approx 125 \text{ barns} \qquad (\text{for } J = 2) ,$$

the associated absorption cross section is negligible compared with the statistical errors in the measured cross sections.

A somewhat more refined estimate of the values of $\sigma(\epsilon)$ can be obtained by assuming an analytic form for this cross section and inverting Eqs. (1) to obtain the values of the constants appearing in the assumed expression for $\sigma(\epsilon)$. In the present case, a single-level formula is used. The constants are E_r (the resonance energy), $\sigma_r = \sigma(\epsilon = E_r)$, and Γ (the width of the resonance). The resolution function in Eqs. (1) is assumed to have the form

$$\rho(x) = A\rho_s(x) + (1 - A)\rho_c(x + \Delta) , \tag{2}$$

where

$$\rho_s(x) = \begin{cases} (2I_1)^{-1} , & -I_1 \leq x \leq I_1 \\ 0 , & |x| > I_1 \end{cases}$$

and

$$\rho_c(x) = \frac{I_2}{\pi} \quad \frac{1}{x^2 + I_2{}^2} \quad .$$

In these equations, A and Δ are adjustable parameters and I_1 and I_2 are obtained in the inversion of Eqs. (1). The results obtained by this type of analysis are given in Table II. These results are tentative and involve only the simplest resolution functions of the form of Eq. (2).

TABLE II. Values of $\sigma_a(E)$ and $\sqrt{\delta^2(E)}$ calculated from the single-level parameters obtained in the inversion of Eq. (1).

Case 1. Square resolution function (A = 1):

σ_r = 119.2 barns, Γ = 0.24 kev, E_r = 27.36 kev, I_1 = 0.19 kev.

Case 2. Cauchy resolution function (A = 0):

σ_r = 110.6 barns, Γ = 0.31 kev, E_r = 27.35 kev, I_2 = 0.14 kev.

	Case 1		Case 2	
E (kev)	$\sigma_a(E)$ (barns)	$\sqrt{\delta^2(E)}$ (barns)	$\sigma_a(E)$ (barns)	$\sqrt{\delta^2(E)}$ (barns)
27.1	33.1	23	34.2	24
27.2	59.6	38	56.2	30
27.3	75.9	32	76.4	35
27.4	76.8	30	76.2	35
27.5	62.8	38	55.9	30
27.6	36.2	25	37.1	24

I - 144-14 Investigation of Scintillators (51300-01)

L. J. Basile and W. L. Buck
Reported by W. L. Buck

MEASUREMENT OF DECAY TIMES

Increasing interest in measuring the decay times of scintillations from strongly-quenched organic solutions and other feebly-luminescent materials has led to efforts directed toward increasing the sensitivity of the apparatus used for that purpose at this laboratory.[1] In order to achieve the desired speed of response (rise time $\approx$ 2 nsec), the detecting photomultiplier (RCA-1P28) has usually been operated with only six stages of electron multiplication. Although nearly the maximum permissible interdynode voltage differences are employed, the resultant gain is still relatively low. The sensitivity of this detector is limited also by the fact that the RCA-1P28 has an internal, opaque photocathode buried within the "squirrel cage" dynode assembly. It is thus not possible to secure optical contact between scintillator and photocathode, and the efficiency of light collection is quite low.

In the hope of increasing the sensitivity without sacrificing speed of response, some work has been done to substitute a Philips 56AVP photomultiplier for the RCA-1P28. The 56AVP is a 14-stage high-gain type capable of linear operation for peak anode currents up to several hundred milliamperes and having a semitransparent end-window photocathode, 42 mm in diameter. The dynodes are of silver-magnesium alloy. These and the input electron-optical system have been designed especially to minimize variations in electron transit time. The over-all rise time is claimed by the manufacturer to be 2 to 3 nsec,[2] and

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[1] R. K. Swank, H. B. Phillips, W. L. Buck, and L. J. Basile, IRE Trans. on Nuclear Sci. NS-5, No. 3, 183-187 (1958).

[2] Information Release (56AVP), Philips Electron Tube Division, c/o Amperex Electronics Corp., Hicksville, L. I., N. Y.

published results of independent measurements seem to confirm this value.[3]

In our preliminary work, the 56AVP was operated with all 14 stages of electron multiplication and with over-all voltages of 2000 to 3000 v, the apportionment of voltage among the various dynodes being according to distribution "B" suggested by the manufacturer.[2] The plastic scintillators employed were coupled to the photocathode window with silicone oil. Scintillations were excited repetitively by very short bursts of 75-kev electrons in the manner described previously,[1] and the resulting electrical pulses were taken in a push-pull manner from the anode and 14th dynode of the 56AVP through matched sections of 120-ohm cable to the deflection helices of an E.G. & G. traveling-wave oscilloscope. The base of the photomultiplier was removed in order to shorten the dynodeand anode leads.

In view of the rather limited amount of experience which we have had with this new detection system, it seems best not to attempt any detailed analysis of its performance for the present report. Results already obtained do tend to confirm the expectation that use of the 56AVP can provide greatly increased sensitivity without sacrifice of time resolution. However, indications are that in order to achieve the optimum performance for our application it will be desirable to reduce the number of dynodes employed and to provide higher interdynode voltage differences than were used initially.

Although these changes may result in some reduction in gain (electron multiplication), the effects of transit-time variations will thereby be further reduced. The greatly increased efficiency of collection of the scintillation light made possible by the end-window photocathode should insure that the over-all sensitivity will be substantially greater than with the RCA-1P28. Since the 56AVP is constructed with a

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[3] C. Cernigoi, I. Gabrielli, and G. Iernetti, Nuclear Instr. and Methods 9, 303-314 (1960).

glass window, the otherwise identical Philips 56UVP with quartz window will be employed in most of the subsequent work in order to boost the sensitivity for ultraviolet scintillations.

It may be of interest to note that the very high gain available with the photomultipliers of this type makes it possible to observe directly the very short pulses resulting from random thermionic emission of single electrons from the photocathode. The shape of these "single-electron" pulses reveals the ultimate impulse response of the detection system.

V. THEORETICAL PHYSICS, GENERAL

V - 1 - 1 The Deformation Energy of a Charged Liquid Drop (51210-01)

S. Cohen and W. J. Swiatecki*
Reported by S. Cohen

It has been suspected for some time that the usual description of the family of saddle shapes for uniformly charged liquid drops is incomplete. In this paper several rather simplified models of the charged drops are discussed and shown to have a feature in common which differs grossly from the usual picture of the behavior of the saddle shapes. The clues given by these simplified models seem to indicate that more than one saddle shape may exist for certain values of the fissionability parameter. A close examination of the more exact previous calculations also indicates the possible presence of this second family of saddle shapes.

This has been discussed in detail in an informal report from Aarhus University entitled "The Deformation Energy of a Charged Drop. IV. Evidence for a Discontinuity in the Conventional Family of Saddle Point Shapes."

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* Lawrence Radiation Laboratory, University of California, Berkeley, California and Institute of Physics, Aarhus University, Aarhus, Denmark.

V - 45 - 17 Meson-Nucleon Interaction (51151-01)

K. Tanaka and M. Marinaro (University of Naples)
Reported by K. Tanaka

The pion-pion resonance contribution to low-energy pion-nucleon scattering has been obtained in closed form by integrating over the circle that characterizes the π - π cut. Its effects on the S-wave amplitude and on the isotopic spin-flip contributions of S- and P-wave amplitudes in π - N scattering were then studied.

The present approach differs from a previous phenomenological method in that one can control and understand the nature of the singularity that is included in the calculation. When the isotopic spin-flip S-wave amplitude in π - N scattering is extrapolated from physical to unphysical values of the square of the total energy, a smooth energy dependence is found in the unphysical region. The π - π contributions to $S_{1/2}$ and $P_{1/2}$ states of π - N are shown to be related by a mass reversal.

A complete report on this work is being prepared and will be submitted soon to Nuovo cimento.

PUBLICATIONS SINCE THE LAST REPORT

PAPERS

RESIDUAL INTERACTION AND THE DEFORMATION OF NUCLEI

A. Arima . . . . (Project V-13)
Nuclear Phys. 24 (1), 69-83 (1961)

STOPPING POWER OF C FOR Po^{210} ALPHA PARTICLES

S. Barkan . . . . (Project I-43)
Nuovo cimento 20 (3), 443-449 (1961)

BRANCHING RATIO OF α AND β EMISSION FROM Bi^{212} (ThC)

S. Barkan . . . . (Project I-44)
Nuovo cimento 20 (3), 450-453 (1961)

NEUTRON EMISSION FROM COMPOUND NUCLEAR SYSTEMS OF HIGH ANGULAR MOMENTUM

H. W. Broek . . . . (Project I-22)
Phys. Rev. 124, 233-245 (October 1, 1961)

ELECTRON BUNCHING IN THE MULTIPACTING MECHANISM OF HIGH-FREQUENCY DISCHARGE

A. J. Hatch . . . . (Project IV-10)
J. Appl. Phys. 32, 1086-1092 (June 1961)

PROPOSAL FOR DETECTING THE POLARIZATION OF SLOW PROTONS

J. Heberle . . . . (Project I-75)
Helv. Phys. Acta, Supplementum VI (1960)

ENERGY LEVELS IN $_{69}Tm^{172}$ FROM THE DECAY OF $_{68}Er^{172}$

R. G. Helmer and S. B. Burson . . . . (Project I-34)
Phys. Rev. 123, 992-996 (August 1, 1961)

DECAY OF Tm^{172}

R. G. Helmer and S. B. Burson . . . . (Project I-33)
Phys. Rev. 123, 978-991 (August 1, 1961)

CONVENIENT MERCURY CUTOFF TO WITHSTAND ATMOSPHERIC PRESSURES

D. C. Hess . . . . (Project II-18)
Rev. Sci. Instr. 32, 746-747 (June 1961)

THE DESIGN OF BUNCHING MAGNETS

R. E. Holland . . . . (Project I-14)
Nuclear Instr. and Methods 12, 103-110 (1961)

ACCURACY OF THE SUPERCONDUCTIVITY APPROXIMATION FOR PAIRING FORCES IN NUCLEI

A. Kerman, R. Lawson, and M. Macfarlane . . . . . (Project V-12)
Phys. Rev. 124, 162-167 (October 1, 1961)

DESIGN AND CONSTRUCTION OF A SYSTEM OF PULSED MAGNETS

R. Kuskowski, T. Novey, and S. Warshaw . . (Unattached)
Rev. Sci. Instr. 32, 674-682 (June 1961)

PRINCIPLES OF CYCLIC PARTICLE ACCELERATORS

J. J. Livingood . . . . (Project I-116)
D. Van Nostrand Co., Inc., Princeton, New Jersey (1961)

SPECTROSCOPY OF GAMMA RADIATION FROM Nd^{144}, Sr^{88}, and Pb^{207}

J. Monahan, S. Raboy, and C. Trail . . . . (Project I-55)
Phys. Rev. 123, 1373-1381 (August 15, 1961)

DESPERSION OF GYROMAGNETIC RATIOS IN COMPLEX SPECTRA

N. Rosenzweig and C. Porter (BNL) . . . . . (Project V-15)
Phys. Rev. 123, 853-855 (August 1, 1961)

CAPTURE GAMMA-RAY SPECTRUM OF $Cd^{113}(n,\gamma)$ Cd^{114} AND THE ASSOCIATED ENERGY LEVELS IN Cd^{114}

R. K. Smither . . . . (Project I-60)
Phys. Rev. 124, 183-192 (October 1, 1961)

SOME EFFECTS OF TEMPERATURE AND VISCOSITY ON THE FLOURESCENCE AND ENERGY TRANSFER IN SOLUTIONS

A. Weinreb . . . . (Project I-144)
J. Chem. Phys. 35, 91-102 (July 1961)

ABSTRACTS

SOLID STATE DETECTORS FOR MEASUREMENT OF dE/ds AND TOTAL ENERGY IN NUCLEAR REACTIONS AT CYCLOTRON ENERGIES

T. H. Braid and J. T. Heinrich . . . . (Project I-111)
International Atomic Energy Agency Conference on Nuclear Electronics, Belgrade, Yugoslavia, May 15-20, 1961. Abstracts of Papers NE/134.

KINETIC-ENERGY DISTRIBUTION OF IONIC FRAGMENTS FROM SOME HYDROCARBONS UNDER ELECTRON IMPACT

J. E. Monahan and H. E. Stanton . . . . (Project II-40)
Bull. Am. Phys. Soc. 6, 356 (June 22, 1961)

ANL TOPICAL REPORT

GEOMETRICAL CONSIDERATIONS IN THE MEASUREMENT OF THE RATIO L/R IN THE SCATTERING OF POLARIZED NUCLEONS

J. E. Monahan and A. J. Elwyn . . . . (Project I-18)
Argonne National Laboratory Topical Report ANL-6420 (October 1961)

INFORMAL REPORTS

THE DEFORMATION ENERGY OF A CHARGED DROP. IV. EVIDENCE FOR A DISCONTINUITY IN THE CONVENTIONAL FAMILY OF SADDLE POINT SHAPES

S. Cohen and W. J. Swiatecki . . . . (Project V-1)
Informal report of the Institute of Physics, University of Aarhus, Aarhus, Denmark

A PHYSICAL DESCRIPTION OF THE PRODUCTION AND DETECTION OF NEUTRONS

D. J. Mueller . . . . (Project I-18)
Co-op student report to Northwestern University

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INTERFERENCE EFFECTS OF RADIOFREQUENCY FIELDS IN RESONANCE RADIATION

M. N. Hack . . . . (Project I-19)
Nuovo cimento (December 1961)

HIGH-FREQUENCY PLASMOIDS

A. J. Hatch . . . . (Project IV-10)
Proceedings of the Fifth Internationl Conference on Ionization Phenomena in Gases, Munich, Germany, August 28 - September 1, 1961

EXPERIMENTAL ANALOG STUDY OF CONTAINMENT OF DENSE PLASMAS IN RESONANT-CAVITY FIELDS

A. J. Hatch and J. W. Butler . . . . (Project IV-10)
J. Electronics and Control

NUCLEAR ENERGY LEVELS OF Na^{24}

C. T. Hibdon . . . .(Project I-98)
Phys. Rev. (October 15, 1961)

ISOTOPIC IDENTIFICATION OF NEUTRON RESONANCES OF Cd, Sb, Os, AND Pt FROM CAPTURE GAMMA-RAY SPECTRA

H. E. Jackson and L. M. Bollinger . . . .(Project I-7)
Phys. Rev. (November 15, 1961)

MAGNETIC MOMENTS OF MIRROR NUCLEI

D. Kurath . . . .(Project V-8)
Phys. Rev. (October 15, 1961)

PROPERTIES OF NUCLEI WITH NEUTRONS AND PROTONS IN THE $1f_{7/2}$ SHELL

R. D. Lawson . . . . (Project V-14)
Phys. Rev. (November 15, 1961)

NEUTRON SCATTERING BY THE COMPLEX HARMONIC OSCILLATOR POTENTIAL

J. Sokoloff . . . . (Project V-12)
Phys. Rev. (November 1, 1961)

SYMMETRY THEORY OF THE AHARONOV-BOHM EFFECT: QUANTUM MECHANICS IN A MULTIPLY CONNECTED REGION

L. J. Tassie and M. Peshkin . . . . (Project V-33)
Ann. Phys. (December 1961)

PERSONNEL CHANGES IN THE ANL PHYSICS DIVISION

NEW MEMBERS OF THE DIVISION

Staff Members

Dr. Ralph E. Segel. Born in New York City, New York, 1928. Married. Ph.D., Johns Hopkins University, 1955. He joined the Physics Division on September 15, 1961 to study nuclear structure by use of the Van de Graaff accelerator.

Dr. Jack L. Uretsky. Born in Great Falls, Montana, 1924. Married; one son, Gordon, 7 years old, and one daughter, Lois, 5-1/2 years old. Ph.D., Massachusetts Institute of Technology, 1956. He joined the Physics Division on September 14, 1961 to work on the theory of diffraction gratings.

Resident Research Associates

Dr. Dieter von Ehrenstein, Physikalisches Institut, Heidelberg University. Atomic beam measurements. Came to Argonne on September 18, 1961. (Host: L. S. Goodman.)

Dr. Kichiro Hiida, Kyoto University. Theoretical study of high-energy ($\gtrsim$ 10 Bev) N-N and π-N inelastic scattering and N-N elastic scattering. Came to Argonne on September 1, 1961. (Host: M. Hamermesh.)

Dr. Michitoshi Soga, Tokyo Institute of Technology. Theory of Nuclear structure. Came to Argonne on August 21, 1961. (Host: D. R. Inglis.)

Dr. Richard K. Spitzer, Purdue University. Field Theory with indefinite metric. Came to Argonne on September 28, 1961. (Host: M. Hamermesh.)

Student Aide (ACM)

Mr. Gerald Nelson, St. Olaf College, Northfield, Minnesota. Working with S. B. Burson on decay schemes of short-lived radionuclides. Came to ANL on September 11, 1961.

Mr. David L. Spears, Monmouth College, Monmouth Illinois. Working with D. C. Hess on mass spectrometric measurements of ionization efficiency. Came to ANL on September 11, 1961.

Mr. Donald Thorstenson, Monmouth College, Monmouth, Illinois. Working with S. S. Hanna on research with the Mössbauer effect. Came to ANL on September 11, 1961.

Student Aide (Co-op)

Mr. Don Camphausen, Purdue University, Lafayette, Indiana. Working with D. C. Hess on the construction of a portable mass spectrometer (MA 27) for use with the Van de Graaff accelerators. Came to ANL on September 11, 1961.

Research Technician

Mr. Robert Feiner. Joined the Physics Division on October 11, 1961 to work with R. O. Lane.

Secretary

Mrs. Eileen E. Bell. Joined the Physics Division on August 1, 1961 as secretary in H wing.

Draftsman

Mr. Richard W. Snyder. Joined the Physics Division on October 2, 1961.

DEPARTURES

Dr. William C. Davidon joined the Physics Division on April 26, 1956. He has worked on the analysis of angular distributions and correlations (Projects V-17 and I-121), dispersion relations (Project V-48), the relativistic mechanics of elastic bodies (Project V-32), elementary particles in De Sitter space (Project V-18), and mathematical logic (Project VI-2). He terminated at ANL on August 25, 1961 to become chairman of the Physics Department, Haverford College, Haverford, Pennsylvania.

Dr. Mirza-Agha Farvar, Iranian Atomic Energy Commission, Teheran, has been at ANL as an affiliate of the International Institute of Nuclear Sciences and Engineering since October 5, 1960. He has collaborated with S. B. Burson on experimental studies of short-lived radioactive nuclides. He terminated at ANL on September 30, 1961 to go to the University of Michigan, Ann Arbor, Michigan.

Dr. Charles M. Huddleston has been on the staff of the ANL Physics Division since March 18, 1953. He has worked on a hydrogen-filled cloud chamber for studies of neutron spectra (Project

I-113), on a high-temperature diffusion cloud chamber (Project I-115), measurement of the half-life of the neutron by use of a diffusion cloud chamber (Project I-117), gaseous scintillation counters (Project I-140), gamma rays from fission induced by thermal neutrons (Project I-52), and self-detection measurements of neutron cross sections (Project I-102). He terminated at ANL on October 13, 1961 to become director of the physics division of the Naval Civil Engineering Laboratory, Port Hueneme, California.

Mrs. Virginia Linquist (secretary in F wing) terminated at Argonne on September 27, 1961.

Mr. Richard Sunde (tracer) transferred to High Energy Physics on August 28, 1961.

Dr. Lindsay J. Tassie, resident research associate from the Australian National University, has been at Argonne since October 12, 1960. He has collaborated with M. Peshkin on the Aharonov-Bohm effect (Project V-33) and with A. S. Reiner (Weizmann Institute) on electron excitation of collective nuclear transitions (Project V-6). He terminated at ANL on October 17, 1961 to return to the Theoretical Physics Department, Research School of Physical Sciences, Box 4 GPO, Canberra, A.C.T., Australia.

Leave of Absence

Dr. William A. Chupka left ANL on August 28 on a Guggenheim fellowship for a year of study and research with Prof. M. Hintenberger at the Max Planck Institute for Chemistry, Mainz, Germany; with Prof. W. Paul at the Institute for Physics, Bonn, Germany;

and with Prof. E. Lindholm at the Institute of Physics, Royal Institute of Technology, Stockholm, Sweden. He plans to work on mass spectrometric studies of high-temperature chemistry and the decomposition of polyatomic ions. He expects to return to Argonne in September 1962.